Trebuchet Manufacturing Instructions

September 12, 2015

Contents

1 How to Use this Document

- Red underlines in the digital PDF are hyperlinks to locations in the PDF or website. You can link these to jump to the hyperlinked location. The example here goes to the 3D model on the last page: Click Me
- The appendix of the digital PDF contains several embedded 3D models of the trebuchets parts. For best viewing experience, please open in Adobe Reader. This software can be downloaded at: `http://get.adobe.com/reader/`
- Parts will be labeled as (A) and a complete list is on page **??**. Fasteners will be labeled as (1) and a complete list is on page **??**. Be sure to print this page at the actual size so you can align up the fasteners directly to the page to identify their numbers.
- Please note that all units in this document are in inches.

2 Introduction

This document details the steps required to create a trebuchet. All tools for construction are listed, as well as recommended tools that may make manufacturing easier. Preliminary assembly instructions are also given so that afterwards anyone may follow the activity sheet instructions for final assembly. For detailed dimensions of each component please view the drawings provided.

Some things to keep in mind when manufacturing the trebuchet

1. When drilling metal, making a hole is a very slow process. It will require a large amount of oil to protect the bit, and several replacement bits if they break.
2. If making more than 1 trebuchet, it is highly recommended that jigs are constructed for repetitive hole groups, such as the holes for the castors.
3. It is highly recommended that a sealer is used on the trebuchet in the case of inclement weather. Thompson's water seal has proven effective.

3 Bill of Materials

- 1 Sheet of $\frac{3}{4}$" Pine Plywood
- 1 Oak 4" X 1" X 8'
- 2 Oak 3" X 1" X 8'
- 1 oak 2" X 4" X 8'
- 1" Wooden Dowel
- $\frac{3}{8}$" Rod
- $\frac{9}{16}$" Pipe Nipple

4 Tools

Required Tools

- Mitre Saw
- Drill
- Jigsaw
- Router
- $\frac{3}{4}$" Forstner Bit
- $\frac{1}{2}$" Forstner Bit
- $\frac{5}{16}$" Drill Bit
- $\frac{3}{8}$" Drill Bit
- $\frac{1}{4}$" Drill Bit
- $\frac{3}{16}$" Drill Bit
- Metal Saw Blade

Recomended Tools

- Drill Press
- Table Saw
- Scroll Saw
- Router Table

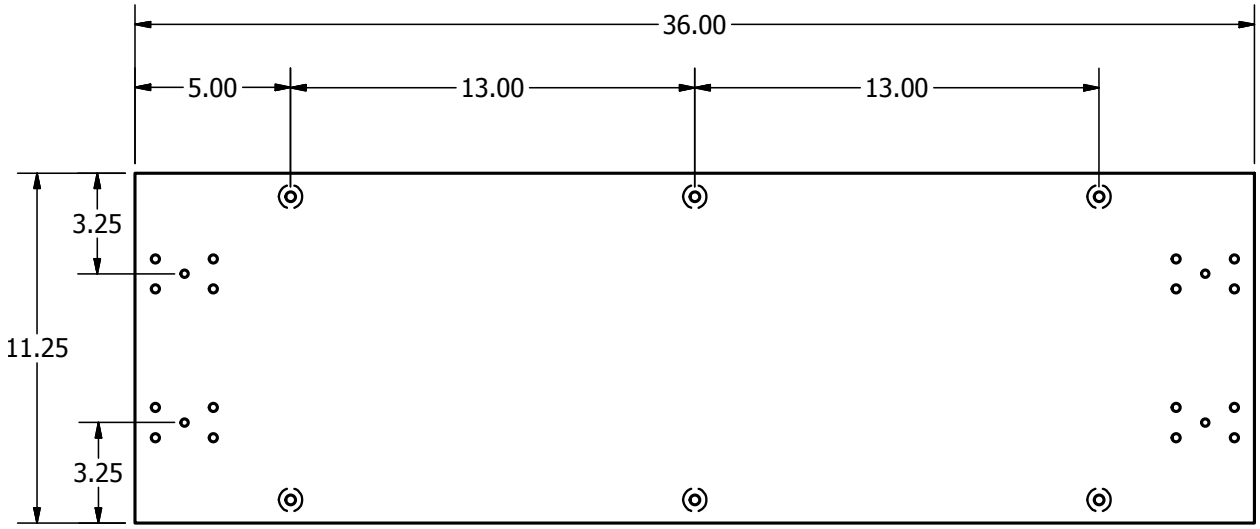
5 Student Kits

-

6 Manufacturing Instructions

6.1 Base

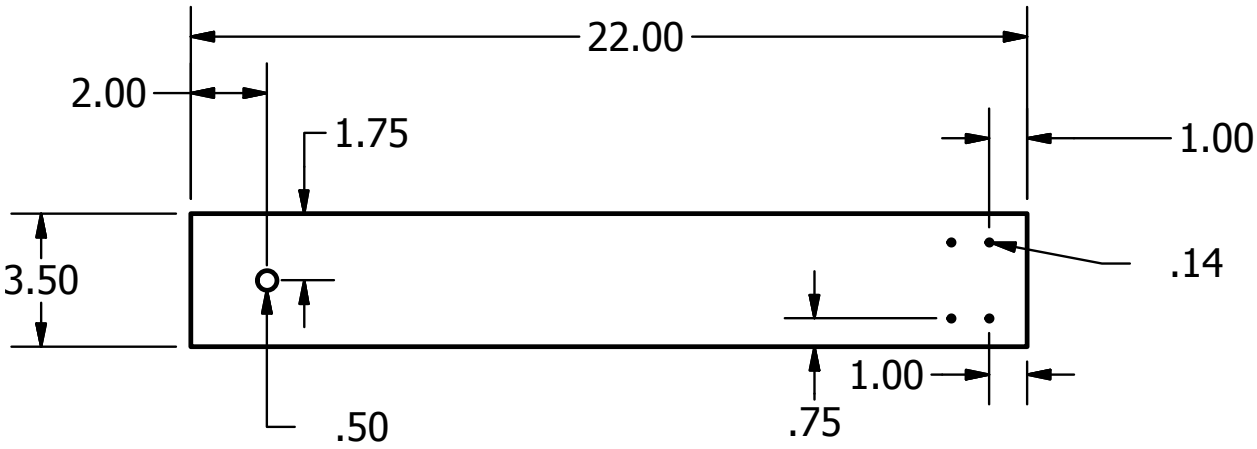
To construct the base start with the sheet of $\frac{3}{4}$" pine plywood. You will need a mitre saw, drill, a $\frac{3}{4}$" forstner bit, $\frac{3}{8}$ drill bit, and a $\frac{1}{4}$" drill bit. For a 3d model of the base please refer to 10



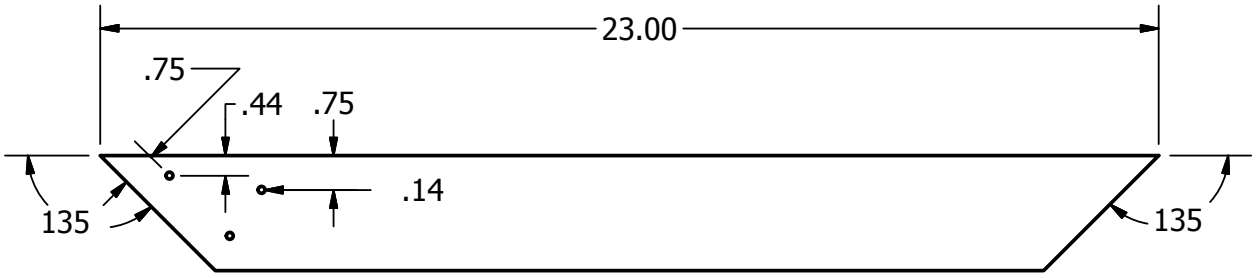
1. Cut the plywood down to a 36" X 11.25" rectangle using a large mitre saw.
   (a) In order to achieve a straight cut it is recommended that you use clamps to secure the plywood to a table before cutting.
   (b) If a tablesaw is available that can accomplish the same task.
2. Cut 6 counterbored holes into the base to secure the supports. These holes are cut with using a drill press, with $\frac{3}{8}$ and $\frac{3}{4}$" forstner bits.
   (a) A drill press is recommended so that the holes are drilled straight and are aligned. If a drill press is unavailable a drill will work just as well.
3. 16 more holes must be drilled into the base, 4 for each castor. Again use a drill press except this time use a $\frac{1}{4}$" drill bit.
   (a) It may be helpful to construct a jig to speed up fabrication, as well as ensuring the holes line up for each castor.

6.2 Shoulder

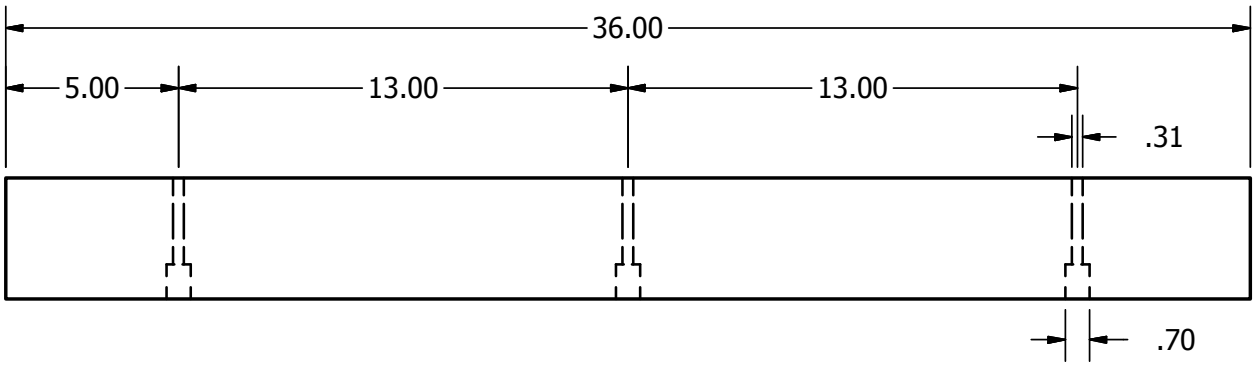
To construct the shoulder you will need an oak 4 X 1, 3 X 1, and a pine 2 X 4, along with a mitre saw, drill, $\frac{1}{2}$", $\frac{5}{16}$", and $\frac{3}{4}$" forstner bits. A vertical upright, 2 diagonal braces, and a cross piece must be constructed for each side. For a 3d model of the shoulder please refer to 11



1. Construct the Vertical upright from an oak 4 X 1.
   (a) Cut this 4 X 1 into two 22" long segments using a mitre saw.
   (b) Cut a hole near the end using a $\frac{1}{2}$" forstner bit.



2. Construct the diagonal brace start with the oak 3 X 1
   (a) Cut the piece into four 22" long segments using a mitre saw.
   (b) Then cut the ends to be at 45° angles, such that the inside length is now 18", while the outside length remains at 23".



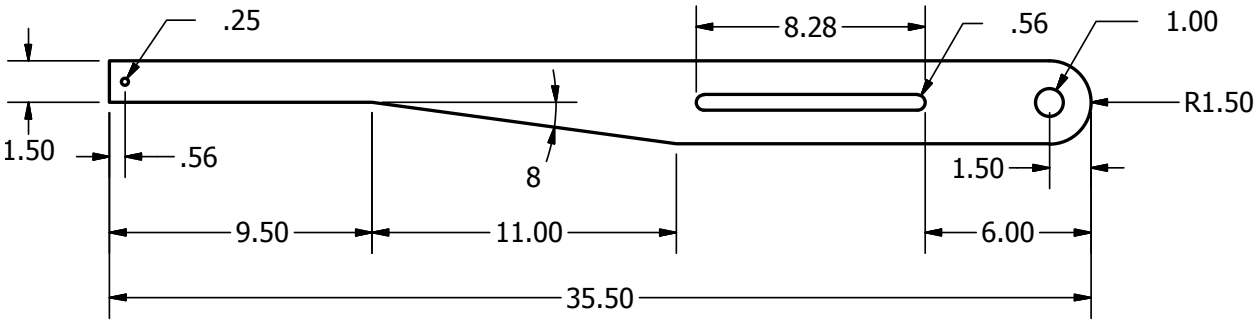
3. Construct the cross piece start from a pine 2 X 4.
   (a) Cut the 2 X 4 into two 36" pieces.
   (b) On the top of each piece 3 counterbored hole must be cut. These holes can be cut using a drill press with $\frac{5}{16}$", and $\frac{3}{4}$" forstner bits.

   To assemble the side supports

   (a) Attach the vertical upright to the cross piece using a drill ans screws.
      i. Make sure that the holes for the vertical upright is on the side opposite to the cross piece.
      ii. Make cure that the holes on the cross piece point upwards.
   (b) Attach the diagonal braces to the cross piece.
   (c) Attach the diagonal brace to the vertical upright.

6.3 Throwing Arm

The throwing arm requires an oak 3 X 1, saw, jigsaw, router, drill, $\frac{1}{4}$" drill bit, and a 1" forstner bit.For a 3d model of the throwing arm please refer to 12



1. Cut the oak 3 X 1 down to 36" using a mitre saw.
   (a) By leaving the arm a little longer, it becomes easier to create an even circle on the end of the arm.
2. Next using a jigsaw trim the back of the throwing arm down to size.
3. Cut a $\frac{1}{4}$" hole in the back end of the arm using a drill.
4. Round the front end of the throwing arm with a jigsaw.
   (a) Remember to shorten the throwing arm while rounding the end.
   (b) If available a scroll saw would make the cut even easier.
5. To cut out the slot for the fulcrum use a router, or a router table.
6. but a 1" hole on the front end using a drill and a 1" forstner bit.

6.4 Fulcrum

The holes will be very small, and they will be on small parts. A vice may hold the parts in place, but it may be useful to construct a clamp, and then place this clamp in a vice for a more secure grip.

Constructing the fulcrum will require a $\frac{3}{8}$" rod, $\frac{9}{16}$" pipe nipple, saw, metal cutting blade, drill, $\frac{3}{8}$" drill bit.

1. Start with the $\frac{3}{8}$" rod
2. Cut this rod down to 10", using a saw with a metal cutting blade.
3. Next place the rode in a vice, and using a drill press with a $\frac{3}{16}$" drill bit cut two holes, on on each end for a pin.
4. Cut the $\frac{9}{16}$" pipe nipple in half with a saw, and metal cutting blade.
5. The center of the nipple will have to be drilled out the fit the rod properly. To do this firmly secure the nipple in a vice and use a drill press to widen the interior hole to $\frac{3}{8}$".
6. The nipple is then placed over the rod and one of the exterior sides of each nipple is threaded.
7. Place one of the half pipe nipples through the rod.
8. Fasten one nut on the nipple, and slide a washer behind the nut.
9. Place the throwing arm through the rod, and fasten the other side the same way.

6.5 Miscellaneous

Wooden dowel to hold the weights

1. Cut the wooden dowel down to 5" using a mitre saw.
   (a) The length of the dowel may change depending on the size of the weights being used.
2. Secure the dowel in a vice, and cut a $\frac{3}{8}$ hole on each end using a drill press.

Create the finger

1. Cut a leftover piece of the wooden dowel to $\frac{7}{8}$" with a mitre saw.

2. Drill a $\frac{1}{4}$" hole through the center of the dowel.
3. Drill a $\frac{5}{16}$" hole down one of the sides of the dowel.
4. It is recommended that you 3d print the sling adjuster so that it is possible to quickly adjust the sling length.

It is recommended that you 3d print the sling adjuster so that it is possible to quickly adjust the sling length. Also printing the castor mount greatly speeds up putting on the castor, only requiring one bolt to be fastened per castor rather than four.

To complete the finger assembly, first place a washer between the arm and the finger. Then slide a bolt through the hole, and on the other side, place 2 washers before the sling adjuster, and tighten a nut on the end.

For a 3d model of the throwing arm sub assembly please refer to 13

7 3D Models

7.1 Base

Default	Front	Back	Right	Left	Top	Bottom	Shaded	Sliced

7.2 Shoulder

Default	Front	Back	Right	Left	Top	Bottom	Shaded	Sliced

7.3 Throwing Arm

Default	Front	Back	Right	Left	Top	Bottom	Shaded	Sliced

7.4 Throwing Arm Sub Assebly

Illustrated Version: Page ??

Default	Front	Back	Right	Left	Top	Bottom	Shaded	Sliced